PATENT ABSTRACTS OF JAPAN

(11)Publication number : 09-138637

(43)Date of publication of application : 27.05.1997

(51)Int.Cl. G09B 9/05
A63F 9/22
G06T 15/00
G09B 9/34
// F41G 3/26

(21)Application number : 07-294121

(22)Date of filing : 13.11.1995

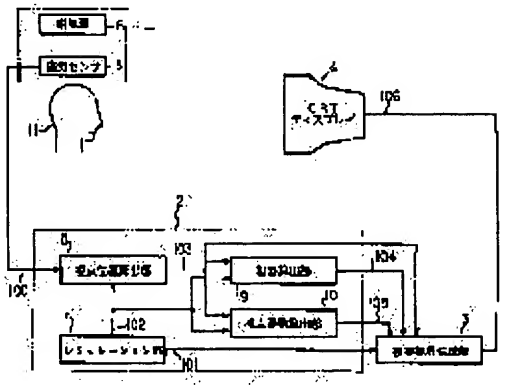
(71)Applicant : MITSUBISHI HEAVY IND LTD

(72)Inventor : KONNO KINUKO
KACHI KOJI

(54) PSEUDO VISIBILITY DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain a sense similar to real experience for a user when it is applied to a simulator, etc., by calculating respective information related to a position of a viewpoint, a visual field and posture in a virtual space based on the position of the head in a rear space, using these information and generating a pseudo visibity image observed from the viewpoint of the user in the virtual space.



SOLUTION: An on-head sensor 1 detects magnetism generated from a magnetic source 6 by a magnetic sensor 5 to output the head position data 100 of the head of the user 11. A visibility display information calculation par 2 is provided with a simulation part 7, a viewpoint position calculation part 8, visual field calculation part 9 and a viewpoint posture calculation part 10, and the simulation part 7 outputs the pseudo calculation result data 101 to a pseudo visibility generation part 3. Further, the part 7 calculates a three- dimensional position of an image display part of a CRT display 4 in the virtual space based on the pseudo calculation result to output the virtual position data 102 to the viewpoint position calculation part 8, the visual field calculation part 9 and the viewpoint posture calculation part 10 respectively.

LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

* NOTICES *

CLAIMS

[Claim(s)]

[Claim 1] Simulation field-of-view equipment which is characterized by providing the following and which generates the simulation field-of-view picture according to operation of a user in the virtual space set up beforehand. A head position detection means to detect the position and posture of a head of a user in a real space. A field-of-view display information calculation means to compute each information about the position of a user's view in a virtual space, a visual field, and a posture based on the position and posture of a head of a user in the real space detected by the aforementioned head position detection means. A simulation field-of-view generation means to generate the simulation field-of-view picture which uses each information about the position of the view in the virtual space computed by the aforementioned field-of-view display information calculation means, a visual field, and a posture, and is observed from a user's view in a virtual space. A simulation field-of-view display means to display the simulation field-of-view picture generated by the aforementioned simulation field-of-view picture generation means.

[Translation done.]

.* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the simulation field-of-view equipment applied to various kinds of simulators or the ** implement for amusement.
[0002]
[Description of the Prior Art] The simulation field-of-view equipment applied to the operation simulator and video game equipment of recent years, for example, an automobile, and the aircraft is developed. Such simulation field-of-view equipment is asked for the function in which feeling equivalent to an actual experience can be obtained according to operation of a user. Changing and expressing the result of the simulation computation which creates the target virtual space and changes according to operation of a user to a simulation field-of-view picture by the computer as one of the methods for this is performed.
[0003] With such simulation field-of-view equipment, a simulation field-of-view picture is generated as follows, for example. That is, based on a user's view in a real space, and the three-dimensions-physical relationship of the display screen, the three-dimensions-position of a user's view in a virtual space and the display screen is set up beforehand. Each information about the posture of the view at the time of seeing the display screen from a view in the size of the visual field at the time of seeing the display screen from a view in the position of the view at the time of seeing the display screen from a user's view in a virtual space and a virtual space based on this set-up position and a virtual space is computed. Based on each information about the position of these views, the size of a visual field, and the posture of a view, the simulation field-of-view picture observed from a user's view in a virtual space is generated.
[0004] Consequently, if conventional simulation field-of-view equipment is applied to the simulator of an automobilism, the view and the display screen in a virtual space will advance with simulation-advance of the automobile of a virtual space. Therefore, the simulation field-of-view picture copied out on the display screen is updated, and it will sense as if a user actually rides in an automobile and it was going on.
[0005] By the way, in conventional simulation field-of-view equipment, the value of each information about the position of a user's view in a virtual space, the size of a visual field, and the posture of a view is set up as constant value, respectively. That is, in conventional simulation field-of-view equipment, the three-dimensions-physical relationship of the view of a virtual space and the display screen was always fixed.
[0006] By the way, generally, in order for a user to move the head or to shake a neck, the three-dimensions-physical relationship of a user's view and display may be changed in a real space. Here, it assumes it to be equivalent to people looking at a scene from an aperture in a real space to see the display screen from a user's view in a virtual space. If the position of a view is changed while people are looking at the scene from the aperture, the scene which is in sight from an aperture will change according to it, and it will be large changeless like the scene of a position near from an aperture. That is, if the position of a view changes in a virtual space, the simulation field-of-view picture of the display screen will change according to it, and the change will be considered that the place near the display screen becomes large in a virtual space.

[0007] However, even if the three-dimensions-physical relationship of the view of a virtual space and the display screen is always fixed in conventional simulation field-of-view equipment as mentioned above, and the position of the view of a real space changed, feeling which the simulation field-of-view picture of the display screen does not change, and is different from an actual experience to a user was given.

[0008]

[Problem(s) to be Solved by the Invention] Even if a user's view moved in the real space since the three-dimensions-physical relationship of the user's view and the display screen in a virtual space was always fixed in conventional simulation field-of-view equipment as mentioned above, the simulation field-of-view picture of a virtual space had the trouble of not changing. this invention aims at offering the simulation field-of-view equipment from which movement of the view of the user of a real space is interlocked with, and the simulation field-of-view picture in a virtual space changes.

[0009]

[Means for Solving the Problem] In order to solve the above-mentioned technical problem, this invention is interlocked with change of the view of a real space, changes the view of a virtual space, and makes it the main point to generate a simulation field-of-view picture. Namely, this invention is set to the simulation field-of-view equipment which generates the simulation field-of-view picture according to operation of a user in the virtual space set up beforehand. A head position detection means to detect the position and posture of a head of a user in a real space, A field-of-view display information calculation means to compute each information about the position of a user's view in a virtual space, a visual field, and a posture based on the position and posture of a head of a user in the real space detected by the head position detection means, Each information about the position of the view in the virtual space computed by the field-of-view display information calculation means, a visual field, and a posture is used. It has a simulation field-of-view generation means to generate the simulation field-of-view picture observed from a user's view in a virtual space, and a simulation field-of-view display means to display the simulation field-of-view picture generated by the simulation field-of-view picture generation means.

[0010] In the simulation field-of-view equipment of such composition, each information about the position of the view in a virtual space, a visual field, and a posture is computed based on the position and posture of a head in a real space. And each computed information is used and the simulation field-of-view picture observed from a user's view in a virtual space is generated.

[0011] Therefore, even when a user moves the head in a real space and a view moves, the view of a virtual space changes according to change of the view of the real space. And a simulation field-of-view picture is generated based on the three-dimensions-physical relationship of the view of a virtual space and the display screen which changed. That is, since a simulation field-of-view picture also changes with movement of the view of the user of a real space, a user becomes possible [obtaining the feeling more near reality].

[0012] Here, the position of the view in a virtual space is the three-dimensions-coordinate of the view in a virtual space. Moreover, the visual field of the view in a virtual space is the size of the virtual space observed when the position of a simulation field-of-view display means is assumed to a virtual space and a simulation field-of-view display means is seen from a view. Furthermore, the posture of the view in a virtual space is the posture at the time of seeing a simulation field-of-view display means from the view of a virtual space, i.e., a user's direction of a visual axis and an inclination on either side.

[0013]

[Embodiments of the Invention]

(Composition of equipment) Drawing 1 is the block diagram showing the composition of the simulation field-of-view equipment concerning the operation gestalt of this invention. This simulation field-of-view equipment is divided roughly, and has the head sensor 1, the view display information calculation section 2, the simulation field-of-view generation section 3, and CRT display 4.

[0014] The head sensor 1 has a magnetometric sensor 5 and the source 6 of the MAG, detects the MAG generated from the source 6 of the MAG by the magnetometric sensor 5, and outputs the head position data 100 which are the

.three-dimensions-position of a user's 11 head.
[0015] The magnetometric sensor 5 consists of a hall device, a magnetic resistance element, etc., is the range which can detect enough the MAG generated from the source 6 of the MAG, and is installed in the place to which a three-dimensions-relative position can be changed to the source 6 of the MAG. Specifically, a magnetometric sensor 5 is installed in the helmet with which a user 11 is covered.
[0016] The source 6 of the MAG is constituted so that uniformly [the three-dimensions-relative position to CRT display 4]. Specifically, the source 6 of the MAG is installed in the seat where a user 11 sits down, and this seat and CRT display 4 join together, and it is constituted.
[0017] The field-of-view display information calculation section 2 of this operation gestalt has the simulation section 7, the view position calculation section 8, the visual field calculation section 9, and the view posture calculation section 10, and is constituted from usual by the general-purpose computer.
[0018] The target virtual space is set up beforehand, and the simulation section 7 performs simulation computation according to operation of a user in this virtual space, and computes the position of the display screen in a virtual space based on the processing result of simulation calculation further.
[0019] Specifically, the simulation section 7 performs predetermined simulation computation according to operation of a user in a virtual space, and outputs the simulation calculation result data 101 which it is as a result of [this] processing to the simulation field-of-view generation section 3. Next, based on the result of simulation calculation, the simulation section 7 computes the three-dimensions-position of the image display section of CRT display 4 in a virtual space, and outputs the virtual position data 102 which it is as a result of [this] processing to each of the view position calculation section 7, the visual field calculation section 7, and the view posture calculation section 10.
[0020] Here, when applying for example, this operation gestalt to an automobilism simulator, the simulation section 7 performs computation which simulates a run of an automobile, and computes the three-dimensions-position in the virtual space currently simulated about the center position of the display screen (by actual automobile, it is equivalent to a windshield) in a virtual space.
[0021] The view position calculation section 8 computes the three-dimensions-position to CRT display 4 in a user's 11 head based on the three-dimensions-physical relationship of the source 6 of the MAG and CRT display 4 which were beforehand determined as the head position data 100 outputted from the head sensor 1.
[0022] The three-dimensions-position to CRT display [in / a user's 11 head / further / in the view position calculation section 8] 4, The three-dimensions-physical relationship of the user's 11 head and view which are set up beforehand, And it is based on each of the virtual position data 102 outputted from the simulation section 7. The three-dimensions-position of a user's 11 view in a virtual space is computed, and the view position data 103 which it is as a result of [this] processing are outputted to each of the simulation field-of-view picture generation section 3, the visual field calculation section 9, and the view posture calculation section 10.
[0023] Here, the view position calculation section 8 makes the center position of a user's 11 both eyes a user's 11 view in calculation of a user's 11 three-dimensions-position in the virtual space mentioned above, and a user 11 assumes that the face is turned in the direction in which CRT display 4 is received, and computes a view position geometrically. In addition, the three-dimensions-physical relationship of a user's 11 head and a view photos a user 11 with a camera etc. beforehand, and takes the data of a position individually, and you may make it set them up based on this data.
[0024] When the display screen of CRT display 4 is seen from a user's 11 view in a virtual space based on the virtual position data 102 outputted from the simulation section 7, and the view position data 103 outputted from the view position calculation section 8, the visual field calculation section 9 computes with what visual field the picture of a virtual space is in sight, for example, shows it in an angle of visibility and the coordinate range of a virtual space, and outputs it as visual field data 104.
[0025] Based on the virtual position data 102 outputted from the simulation section 7, and the view position data 103 outputted from the view position calculation section 8, the view posture calculation section 10 computes the

.posture of a user's 11 view, i.e., a user's 11 direction of a look and an inclination on either side, for example, shows it at a matrix, an angle, etc., and is outputted as view posture data 105.

[0026] Drawing 2 is drawing having shown the example of the view position data 103 in this operation gestalt, the visual field data 104, and the view posture data 105. It assumes seeing the display screen 13 of CRT display 4 from a user's 11 view 12 in a virtual space now. In this case, the view position data 103 of a view 12 are shown by the coordinate (x y, z) of a virtual space. Moreover, the visual field data 104 of the virtual space when seeing the display screen 13 from the position of a view 12 are shown by the angle of visibility theta which is an angle with the straight line which connected the straight line which connected the view 12 and the center 14 of the display screen 13, and a view 12 and the upper right edge 15 of the display screen 13. Furthermore, the view posture data 105 of a view 12 are shown as vectors alpha, beta, and gamma about the center 14 of the display screen to a view 12.

[0027] Simulation field-of-view generation equipment 3 generates the simulation field-of-view picture 106 based on each of the simulation calculation result data 101 outputted from the simulation section, the view position data 103 outputted from the view position calculation section 8, the visual field data 104 outputted from the visual field calculation section 9, and the view posture data 105 outputted from the view posture calculation section 10, and outputs it to CRT display 4.

[0028] CRT display 4 displays the simulation field-of-view picture 106 which simulation field-of-view generation equipment 3 generated to a user 11. Next, operation of this operation gestalt is explained below.

[0029] (Operation of this operation gestalt) First, a user 11 is covered with the helmet with which the magnetometric sensor 5 was formed, and assumes that equipment was started. A magnetometric sensor 5 detects the MAG of the source 6 of the MAG, computes the three-dimensions-position of a user's 11 ******, and outputs it to the view position calculation section 8 as head position data 100.

[0030] On the other hand, the simulation section 8 performs predetermined simulation computation, and position detection processing of the head in a magnetometric sensor 1 outputs independently the simulation calculation result data 101 which it is as a result of [this] processing. This simulation calculation result data 101 is inputted into the simulation field-of-view generation section 3.

[0031] Furthermore, based on the processing result of simulation calculation, the simulation section 8 computes the three-dimensions-position of the display screen of CRT display 4 in a virtual space, and outputs the virtual position data 102 which it is as a result of [this] calculation. This virtual position data 102 is inputted into each of the view position calculation section 8, the visual field calculation section 9, and the view position calculation section 10.

[0032] Next, based on the head position data 100 and the virtual position data 102, the view position calculation section 8 computes the three-dimensions-position of a user's 11 view in a virtual space, and outputs 103 for the view position data which it is as a result of [this] calculation. This view position data 103 is inputted into each of the simulation field-of-view generation section 3, the visual field calculation section 9, and the view posture calculation section 10.

[0033] Next, the visual field calculation section 9 computes the visual field of the virtual space at the time of seeing the display screen of CRT display 4 from a user's view position in a virtual space based on the virtual position data 101 and the view position data 103, and outputs the visual field data 104 which it is as a result of [this] calculation. This visual field data 104 is inputted into the simulation field-of-view generation section 3.

[0034] On the other hand, independently [the visual field calculation section 9 mentioned above], based on the virtual position data 101 and the view position data 103, the view posture calculation section 10 computes the posture of a user's 11 view in a virtual space, and outputs the view posture data 105 which it is as a result of [this] calculation. This view posture data 105 is inputted into the simulation field-of-view generation section 3.

[0035] Next, based on each of 103, the visual field data 104, and the view posture data 105, the simulation field-of-view generation section 3 generates the simulation field-of-view picture 106, and outputs view position data. This simulation field-of-view picture 106 is displayed on CRT display 4.

[0036] In this operation gestalt, movement of a user's 11 view in a real space is interlocked with, the view of the user 11 of a virtual space changes, the result is taken into consideration, and the simulation field-of-view picture 106 in a virtual space is generated as mentioned above. Therefore, according to the movement of the view of the user 11 of a real space, the simulation field-of-view picture 106 in a virtual space changes.

[0037] Drawing 3 is drawing showing the example of change of the simulation field-of-view picture 106 accompanying movement of the view in this operation gestalt. Here, while seeing the display screen 13 of CRT display 4 from the view 16, the tree 18 of a virtual space is displayed on the display screen 13 like a picture 20. A user 11 leans out in now, for example, a real space, and it is assumed that a user's 11 view moved from the view 16 to the view 17. In this case, since the stone 19 other than a tree 18 can be seen from a view 17 in a virtual space, a picture 21 is displayed on the display screen 13.

[0038] As mentioned above, even if a user moves the head in a real space and a view moves this operation gestalt, the simulation field-of-view picture which should be in sight from the view according to it is displayed. Therefore, it senses as if seeing a CRT display to a user observed the scene through the actual aperture, and it becomes possible to obtain the feeling more near reality.

[0039] this invention is not limited to the above-mentioned operation gestalt, can deform variously as follows and can be carried out.

(1) With the above-mentioned operation gestalt, although position detection processing of a head was performed by the head sensor 1 which has a magnetometric sensor 5 and the source 6 of the MAG, it may be performed by the image processing in the picture which photoed a gyroscope sensor, the ultrasonic sensor, the sensor of a laser method, the sensor of radar system, or the head with the camera etc. For example, since it can detect in [not only the position of a head but the inclination of a head] three dimensions when using a gyroscope sensor, calculation of a more exact view position is attained. Moreover, individually, it may combine and these may be carried out.

(2) With the above-mentioned operation gestalt, although the view posture was computed based on the result of position detection of a head, you may carry out direct detection of the eyeball operation using the eye marker equipment which detects eyeball operation. If it does in this way, since the direction of a user's visual axis can detect directly, it becomes unnecessary to calculate a view posture by assuming that the user is looking at the center of the display screen of a CRT display like the above-mentioned operation gestalt, and a more exact view posture can be computed.

(3) With the above-mentioned operation gestalt, although constituted by the general-purpose computer, each function of the visual-axis display information calculation section 2 may be divided into two or more general-purpose computers, and, as for the visual-axis display information calculation section 2, the control unit of exclusive use etc. may replace a part of each function. Furthermore, you may also include a part or all of each function of field-of-view information calculation equipment 2 in the interior of simulation field-of-view generation equipment 3.

(4) Although the display of a simulation field-of-view picture was performed using CRT display 4 with the above-mentioned operation gestalt, you may transpose to various kinds of display, such as a projector.

[0040]

[Effect of the Invention] According to this invention, the simulation field-of-view equipment from which movement of the view of a real space is interlocked with, and the simulation field-of-view picture in a virtual space changes can be offered as mentioned above. Therefore, when this invention is applied to a simulator etc., a user can get feeling similar to an actual experience.

[Translation done.]

.* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The block diagram showing the composition of the simulation field-of-view equipment concerning the operation gestalt of this invention
[Drawing 2] Drawing having shown the example of the view position data in this operation gestalt, visual field data, and view posture data
[Drawing 3] Drawing showing the example of change of the simulation field-of-view picture accompanying movement of the view in this operation gestalt
[Description of Notations]
1 -- Head sensor
2 -- View display information calculation section
3 -- Simulation field-of-view generation section
4 -- CRT display
5 -- Magnetometric sensor
6 -- Source of the MAG
7 -- Simulation section
8 -- View position calculation section
9 -- Visual field calculation section
10 -- View posture calculation section
11 -- User
12 -- View
13 -- Display screen
14 -- Center
15 -- Upper right edge
16 17 -- View
18 -- Tree
19 -- Stone
20 21 -- Picture
100 -- Head position data
101 -- Simulation calculation result data
102 -- Virtual position data
103 -- View position data
104 -- Visual field data
105 -- View posture data
106 -- Simulation field-of-view picture
x y, z -- Coordinate of a view position
theta -- Angle of visibility

·alpha,·beta, gamma -- Vector of a view posture

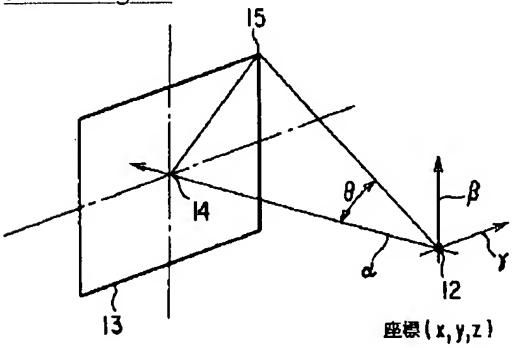
[Translation done.]

* NOTICES *

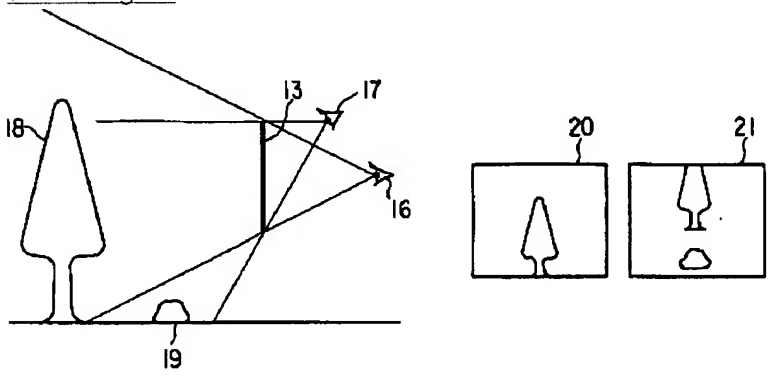
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

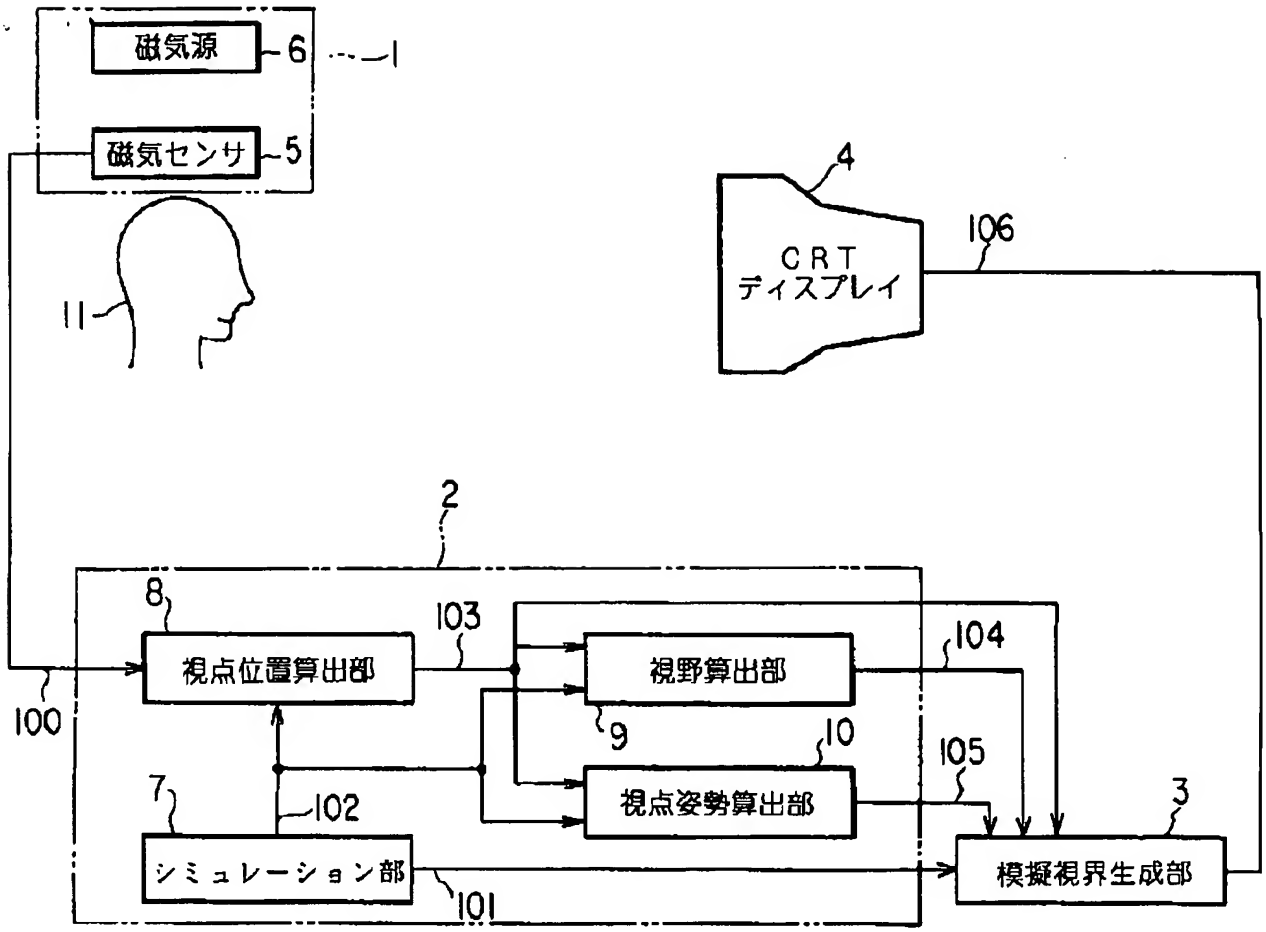
[Drawing 2]



[Drawing 3]



[Drawing 1]



[Translation done.]